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Financial Instability and Credit Constraint: evidence from the cost of bank financing[*]

Bruno S. Martins[**]

Abstract

This paper examines the relation between the degree of firms' financial constraint and the observed rise in the cost of bank financing during the global financial crisis of 2008. It introduces a new measure of financial constraint: the lending rate paid by each firm on working capital loans. In line with previous research, the findings point to a more severe contraction in credit supply for more credit constrained firms. Additionally, the results show that the existence of collateral and a large portfolio of lenders mitigate the credit supply contraction observed in that period.

Keywords: Financial crisis, financing constraints, cost of bank financing
JEL Classification: G31

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1. Introduction

One of the key issues raised by the global financial turmoil of 2008 and its deep impact on the supply of credit worldwide is the effect of financial dependence on corporate investment decisions. However, to identify this relation it is necessary first to investigate to what extent the transmission of a credit supply shock is correlated with the degree of corporate financial constraint. Nevertheless, there are still conflicting conclusions in the literature about how a credit crunch is spread through economic agents, specifically among corporations.

Even in economies with strong macroeconomic indicators and where the financial system proved to be reasonably healthy, the tightening in credit was extremely costly, generating large job losses and steep reductions in output. In this context, the global financial crisis of 2008 seems to represent a strictly exogenous shock to the Brazilian economy, providing a unique opportunity to study the transmission of exogenous shocks through the economy.

This paper analyzes the behavior of the Brazilian credit market in the months immediately following the announcement of the Lehman Brothers (LB) failure in September 2008[1]. Using micro data on bank credit transactions it examines the relation between the degree of firms' financial constraint and the change in the cost of bank financing during the crisis. The article presents a new measure of corporate financial constraint: the effective cost of bank financing (the lending rate paid by each firm) during "normal times"[2]. The theme is relevant as it identifies which kind of firms suffer more financial constraints in times of crisis, helping governments to meet the growing demand for directed credit in those periods.

A large finance and macroeconomics literature has studied the reasons why some firms are more credit constrained than others and how these limitations affect their investment decisions and business cycles. Issues related to agency problems, as in Jensen and Meckling (1976), Grossman and Hart (1982) and Hart and Moore (1995), and information asymmetry, as in Myers and Majluf (1984) and Greenwald, Stiglitz and Weiss (1984), are widely treated as major sources of financial frictions. An important

[1] The combination of strong economic growth, a robust financial system and low dependence on the export sector allows me to assume that the failure of LB was a strictly exogenous adverse shock in the Brazilian economy.

[2] Two periods were considered as "normal times": between January 2006 and May 2008 and from January 2006 to December 2007.

topic is the balance sheet effect, where the condition of borrowers' net worth is a source of output dynamics (Bernanke and Gertler, 1989). This mechanism works through the value of collateral, which increases during economic booms, reducing agency costs and increasing investment, which amplifies the upturn.

In an attempt to measure the effects of financial constraint on the performance of companies, most articles focus on the search for good indicators to classify firms as financially constrained or not. Due to the unavailability of data on each credit transaction, previous research has used proxies such as firm size, age, credit ratings, dividend payout and the type of control to measure constraints. Even a survey of 1,050 CFOs has been used (Campello, M.., et al., 2010). However, none of them precisely reflects the difference between the cost of internal and external financing for each firm[3]. These are just indicators that are apparently related to agency problems and information asymmetry. For example, is a firm that does not distribute dividends accumulating resources due to the high cost of external financing or because the present value of these funds invested in new projects is higher than the current dividend? Does the credit rating reflect a firm's degree of financial constraint or just its business risk? Furthermore, firm size may also not be an accurate measure of financial constraint, since to generate a given amount of revenue firms in some industries require a greater amount of capital employed than others.

Using a single database, at the level of each credit transaction, here I propose a more accurate measure of financial constraint: the interest rate paid by each customer (firm) on a bank loan. This indicator reflects the effective cost of bank financing for each firm and therefore better reflects the difference between the cost of internal and external financing.

In line with Campello, M. et al, my findings show that the impact of the financial crisis was more severe on constrained firms, for which the percentage increase in the cost of bank financing was even higher during the peak of the global financial crisis of 2008. The findings are robust to different measures of financial constraint, such as the minimum and the average cost of bank financing and the total volume of loans obtained by each firm during "normal times".

[3] This is usually used to define a financial restriction. In this case, any firm that faces a higher cost of external financing to internal financing should be classified as financially constrained, and this difference is a measure of the degree of constraint faced by it.

A firm's degree of financial constraint changes its optimal capital structure, asset allocation and payout decisions. Some studies show that constrained firms are more able to use their cash flows to finance new projects than less constrained ones (Fazzari, Hubbard and Petersen, 1988) and are therefore less dependent on the financial sector. Thus, more important than identifying the degree of firms' financial constraint is examining what happens in the credit market during periods of financial instability. If the increase in the cost of bank financing is more severe for firms that are less credit constrained, then the quality of the projects being funded in the economy tends to worsen, raising the risk of default in the future.

This article is organized as follows: the second section presents some descriptive statistics on the Brazilian credit market; the third section brings the empirical strategy, the fourth shows the results and the fifth concludes.

2. Pre-Crisis Bank Credit in Brazil

This section presents the recent evolution of the credit market in Brazil, focusing on the period immediately before the eruption of the global financial crisis in September 2008. The idea is to present some stylized facts that corroborate the hypothesis assumed in this study that the announcement of the Lehman Brothers' failure was a strictly exogenous shock in the Brazilian economy.

Figure 1 below shows the evolution of credit to GDP ratio for non-directed loans ("free credit") and those made under required government lending programs between January 2004 and December 2009, where the dotted line indicates when LB failed. It can be seen that the strong growth in the share of free credit to GDP ratio suffered only a mild slowdown in late 2008 and that the contribution of directed credit, mainly through BNDES (the national development bank), provided reasonable stability around 10% to 15% of GDP (growth of 50% in just one year).

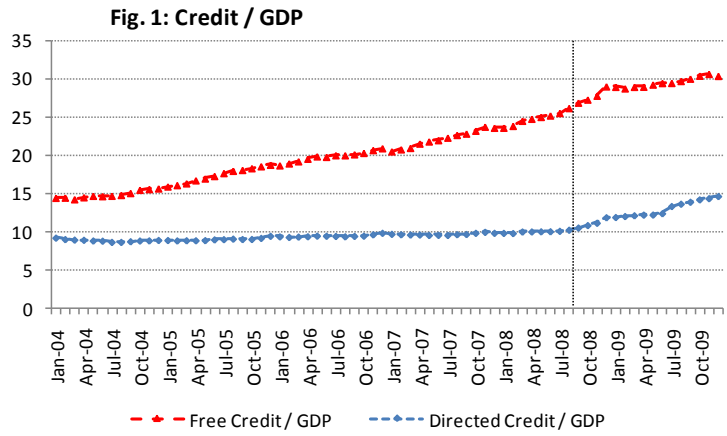
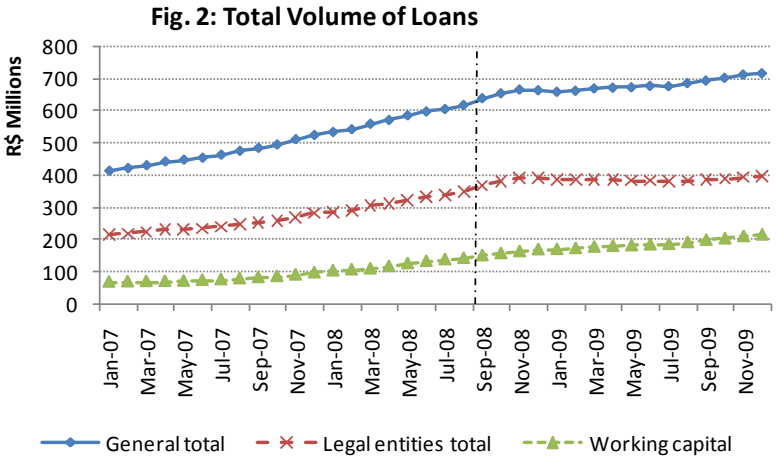


Figure 2 shows the evolution of the total balance of free credit, balance of free credit for companies and for working capital, in millions of reais, between January 2007 and December 2009. Note that the global financial crisis of 2008 had little impact on the volume of bank credit in the Brazilian economy.



Despite the limited impact on the volume of credit, the same cannot be said about the cost. Figures 3 and 4 show the evolution of the average interest rate charged by banks for different types of loans.

Fig. 3: Average Interest Rate on Loans

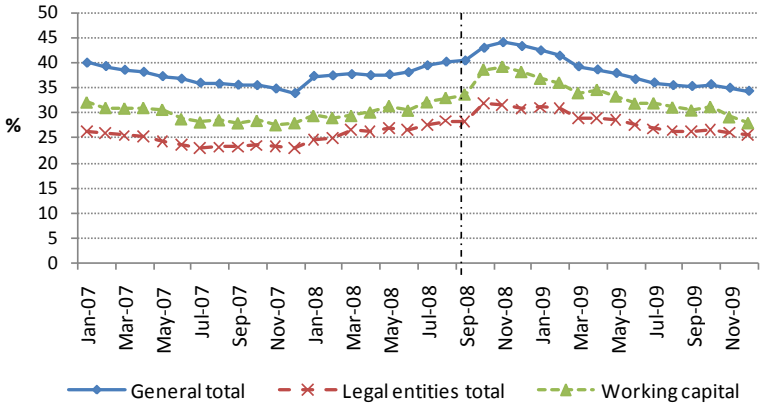
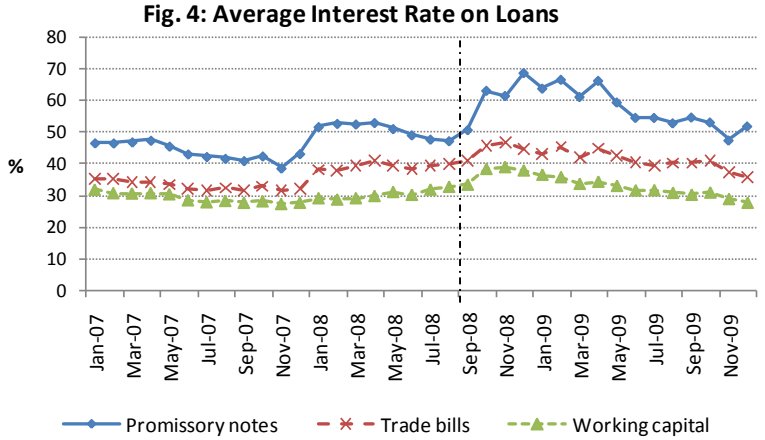


Fig. 4: Average Interest Rate on Loans



Although there was a small increase in the average cost of bank financing in the months preceding September 2008, interest rates rose sharply in the six months following the outbreak of the crisis, before returning to pre-crisis levels during 2009.

Despite the strong economic expansion in the pre-crisis period, the quick rise in the cost of bank credit in late 2008, partly explained by the expected increase in default rates, also reflected the increase in risk aversion in the financial market at that time. This deep and sudden change in the cost of credit raises the question of how it was distributed among firms and which factors mostly attenuated this effect on them. These issues are investigated in the next section.

3. Empirical Strategy

The purpose of this study is not to identify different sources of market imperfections and their impacts on investment decisions, but rather to indicate which factors contribute the most to attenuate the credit supply contraction observed in periods of

high financial instability. In this sense, I focus on examining the behavior of the interest rates charged on loans for working capital in the three months after the LB failure, between October and December 2008, relative to the previous three months, between June and August 2008.

The choice of working capital is justified by the emergency aspect of this type of credit and because it is usually a short-term arrangement. That is, unlike credit to finance investment and acquisitions, loans for working capital reflect companies' needs to continue meeting their short-term obligations to suppliers, employees etc. during downturns and hence are less likely to be postponed or subject to a demand shock. Thus, it is reasonable to assume that, at least in the short run, the behavior of the interest rate charged on this type of loan will be more associated with supply shocks than demand ones.

In relation to the period adopted, the objective is also to reduce identification problems that could arise regarding supply and demand effects. Thus, the option for just three months before and three months after LB's failure aims to reduce the impact of other factors that could alter the interest rates charged on these loans. Moreover, the period selected includes both a reasonable period of optimism regarding the probability of default as well as the period of greatest instability in the credit market in Brazil (fourth quarter 2008).

Thus, the entire data set consists of a pooled cross-section of firms that obtained bank loans for working capital three months before and three months after LB's failure, where the variable of interest is the change in the cost of bank financing. The minimum and the average lending rate paid by each firm between January 2006 and May 2008, as well as the total volume of borrowings, were collected to build some measures of financial constraint. In addition, the model contains some variables traditionally treated in the literature as indicators of credit constraints, such as firm size, and as proxies for financial dependence, like the economic sector of the firm (Rajan and Zingales, 1998). Finally, the fixed effects of each bank are captured by dummy variables.

In the following subsections I present the database and the econometric specification used.

a. Database

The database is private, and comes from the Brazilian Central Bank Credit Information System (SCR). This database provides information of all loan contracts above R$5,000.00 (approximately U$2,700.00). The data set is confidential and protected by banking privacy law, only providing information on financial institutions as some customer features, such as geographic location, industry, size and credit rating, the last two being assigned by the lending institution itself. I tallied all free credit transactions to finance companies' working capital at fixed interest rates between June 2008 and December 2008, for a total of 575,346 loans, from 95 financial institutions[4] to 324,069 firms[5]. For the empirical exercise, I excluded from the sample all loans originated in September 2008[6] and all firms that borrowed only before LB's failure (June-August 2008) or after it (October-December 2008). Thus, I selected only firms that took credit for working capital in these two periods, totaling 59,130 firms and 83 banks.

Since it is impossible to identify the reasons why some firms only took out loans before LB's failure, I just present some statistics on them, such as the number of firms and the average cost of bank financing between June and August 2008. Altogether, 116,917 firms took working capital loans between June and August 2008 and did not do so again between October and December. It is worth mentioning that a firm's decision to finance its working capital with bank loans in a given period may be associated with its ability to attract other sources of funding, its own business cycle or even the possible changes in resource needs according to its investment projections. Thus, some problems of selection bias may arise.

My data set was collected at the transaction level, which allowed me to assemble information on credit volume, average and minimum interest rate, total provision for

[4] I considered only the financial institutions belonging to the following segments: commercial banks, commercial bank cooperatives, foreign commercial banks with branches in the country, Banco do Brasil and Caixa Econômica Federal (both government-controlled full service banks), and mutual banks.
[5] I also excluded all transactions from interbank transfers, co-obligations, claims to release, related-party transactions and loans written off.
[6] I assumed the beginning of the crisis to be the announcement of the Lehman Brothers bankruptcy in September 2008. Even though it was more a consequence of the existing unfolding crisis, the failure of LB marked the start the contagion on the Brazilian economy. Thus, I excluded September from the sample because of the difficulty of classifying the loans in this month as being before or after the crisis.

future losses, credit risk classification[7] and firm size[8] of each borrower before and after the crisis. In addition, I created other indicators for control purpose, such as the length of relationship with the borrower, the maturity of the loan, the number of banks from which each firm obtained credit and the proportion of loans from government-controlled banks[9], both before and after the crisis.

The interest rates were obtained from the average of all transactions per firm whose annual nominal interest rates were above 12% and below 200%[10], weighted by volume. The credit risk classification was obtained by both the average and the worst risk rating of each customer. As a proxy for firm size, I used both the total amount of credit obtained by each borrower between June and December 2008 (continuous variable) as the average size reported by financial institutions (dummy variable).

From the final sample, I obtained the percentage change in the weighted average interest rate paid by each company after the outbreak of the global financial crisis. I constructed three measures of financial constraint, the minimum and the weighted average interest rate paid by each borrower between January 2006 and May 2008 and the total volume of loans taken in that period[11]. I believe my credit restriction indicator is better than those frequently used in the literature, not only because it is a continuous measure, but also because it represents the effective average cost of external (bank) financing of each firm.

Table 1 presents some statistics on loan volume, interest rate and the total number of firms and banks for the entire sample and for some subsamples.

[7] The risk rating of the customer, ranging from AA (low risk) to HH (high risk), is reported by the lending institution, but must follow certain criteria for this classification established by the National Monetary Council.
[8] The size of the customer (1: Micro, 2 Small, 3: Medium or 4: Large) is also reported by the lender.
[9] A bank controlled by the government, either wholly owned or by holding the majority of the voting capital.
[10] Several banks had annual nominal interest rates below 12% or above 200%, which are clearly out of line with the rest of the market. I discarded those transactions and other missing values from the sample. Moreover, the 12% cutoff is justified by the fact that an important bank reported annual interest rates of 12% for all of its customers.
[11] For robustness, the period between January 2006 and December 2007 was considered.

Table 1

Sample period:	# of firms	# of banks	Average Loans Pre - Crisis	Average Loans Post- Crisis	Average Interest Rate Pre-Crisis	Average Interest Rate Post-Crisis
Only Post-Crisis	174,058	80		147,569		53.40
				(13,597,470)		(21.64)
Both Periods	59,130	83	158,509	167,850	46.92	53.26
			(1,039,017)	(1,419,110)	(21.17)	(19.07)
Only Pre-Crisis	176,047	86	96,772		49.21	
			(805,552)		(25.00)	

Note: Standard erros in parentheses.

Note that all firms that took credit in the pre-crisis period had, on average, a smaller volume of credit and paid higher interest rates than those that obtained credit in both periods. This observation may indicate that, in general, the credit supply shock was more severe for smaller and more financially constrained firms. On the other hand, as already mentioned, several factors may be correlated with the absence of credit transactions during the height of the crisis. Table 1 also shows that the rise in the interest rates for firms with credit transactions in both periods, from 46.92% to 53.26%, reflects an increase of 13.51% in the cost of bank financing. Table 2 below shows the distribution of the average interest rates among customers with different credit risk classifications (worst risk rating).

Table 2

Worst Credit Rating	# of firms	Average Interest Rate Pre-crisis	# of firms	Average Interest Rate After-crisis	Var. % Interest Rate
AA	6,802	42.20	5,941	53.64	27.11%
		(15.56)		(17.92)	
A	24,677	46.92	24,171	52.89	12.72%
		(17.69)		(17.64)	
B	10,409	47.52	10,881	48.19	1.41%
		(32.60)		(22.47)	
C	14,639	49.26	15,210	58.09	17.93%
		(18.41)		(18.29)	
D-H	2,603	41.70	2,927	48.73	16.86%
		(16.64)		(16.07)	

Note: Standard erros in parentheses.

Table 2 shows that firms with the lowest credit risk rating (AA) experienced the highest increases in the cost of bank financing during the crisis (27.11%), reducing the difference with risky ones. Table 3 below shows the same statistics aggregating the firms by ranges of loan loss provision to total loan ratio. In contrast to Table 2, Table 3 shows that the rise in the lending rate was even higher for riskier firms, indicating that the credit risk rating reported by lenders may not be a good measure of credit risk.

Table 3

Loan Loss Provision / Total Loan	# of firms	Average Interest Rate Pre-crisis	# of firms	Average Interest Rate After-crisis	Var. % Interest Rate
< 1%	42,718	46.18	42,361	51.28	11.04%
		(22.11)		(18.97)	
1% - 2%	3,136	42.94	3,694	50.76	18.21%
		(17.26)		(17.76)	
2% - 3%	2,226	44.49	1,852	54.03	21.44%
		(16.45)		(16.51)	
> 3%	10,993	51.47	11,223	61.52	19.53%
		(18.39)		(18.00)	

Note: Standard erros in parentheses.

Table 4 shows the same statistics aggregating the firms by the total volume of loans obtained between June and December 2008.

Table 4

Firm Size by total volume:	# of firms	Average Interest Rate Pre-crisis	Average Interest Rate After-crisis	Var. % Interest Rate
< R$ 100 thousand	35,264	52.54	58.89	12.08%
		(22.03)	(18.91)	
R$ 100 thousand - R$ 0.5 million	18,031	41.51	47.61	14.69%
		(17.24)	(16.04)	
R$ 0.5 million - R$ 1 million	2,936	33.47	40.67	21.51%
		(11.77)	(13.82)	
> R$ 1 million	2,899	27.89	34.65	24.23%
		(12.69)	(13.96	

Note: Standard erros in parentheses.

Curiously, the percentage change in the average interest rates was higher for larger firms (24.23% for those that borrowed more than R$ 1 million, 21.51% from R$ 500 thousand to R$ 1 million, 14.69% from R$ 100 thousand to R$ 500 thousand and 12.08% for those that borrowed less than R$ 100 thousand). A priori, it seems that the credit contraction was even stronger for larger firms during the financial crisis of 2008. This could be explained by the fact that since the 2008 crisis was even stronger in developed countries, the increase in the credit risk was even higher for export firms, which are usually larger ones in Brazil. The doubt is whether the firm size is related to other factors that may change the credit risk in periods of high financial instability.

Additionally, Table 8 in the appendix provides some statistics for firms grouped by their economic sector. There is no evidence that a specific sector represents a significant part of the statistics presented so far. Nonetheless, I added dummy variables for those sectors in the econometric model. The next subsection presents the econometric specification adopted in the study.

b. Econometric Specification

The object of interest is not to identify standard features that would be correlated with credit constraint, but rather to examine if there is a correlation between the degrees of firms' financial constraint and the observed rise in the lending rates during periods of high financial instability. Here, the measure of credit constraint is the cost of bank financing in "normal times", given by the minimum and the average interest rates on working-capital loans between January 2006 and May 2008. Thus, the model is estimated using a pooled cross-section[12], where the dependent variable is the percentage change in the average interest rate charged for working capital loans for each firm between the three months after and before the outbreak of the financial crisis of 2008. The baseline specification is:

$$ln\left(\frac{y_{2,j}}{y_{1,j}}\right) = \alpha + \beta Constraint_j + \theta Size_j + \rho Risk_j + \mu \Delta Risk_j + \varphi Num_{Banks\,j} + \eta \Delta Maturity_j + \delta Relationship_j + \sigma \Delta Prop_{\,Gov\,j} + \sum_{b=1}^{83} \gamma^b D_j^b + \sum_{s=1}^{25} \delta^s D_j^s + \varepsilon_j$$

where $y_{2,j}$ is the average interest rate paid by firm j between October and December 2008, $y_{1,j}$ is the average interest rate paid by firm j between June and August 2008, $Constraint_j$ is the measure of credit constraint of firm j, $Size_j$ is the log of the total volume of loans between June and December 2008 of firm j, $Risk_j$ is the ratio of total loan loss provision to total loans between October and December 2008 of firm j, $\Delta Risk_j$ is the change in the ratio of total loan loss provision to total loans after the crisis (between October and December 2008 and June and August 2008) of firm j, $NumBanks_j$ is the number of banks from which firm j obtained loans before the crisis (between June and August 2008), $Maturity_j$ is the log of the number of days until the maturity of the loan, $Relationship_j$ is the log of the length of relationship during the crisis, in days, and $Prop\_Gov_j$ indicates the proportion of loans obtained from government-owned banks by firm j. D_j^b and D_j^s are dummy variables indicating the bank from which the firm obtained the loan and the firm's economic sector, respectively.

[12] An analysis with panel data was also attempted. However, due to the high imbalance, this proved ineffective.

For robustness purposes, I used three measures of constraint: (1) the minimum interest rate paid on loans before the outbreak of the crisis, between January 2006 and May 2008, (2) the average interest rate paid on loans before the outbreak of the crisis, between January 2006 and May 2008, and (3) the log of the total volume of loans granted in that period. I also used the period between January 2006 and December 2007. I believe these are reasonable measures because the interest rate is a nearly perfect indicator of credit constraint in the sense that it portrays the cost of bank financing for each firm.

The subject of interest here is to quantify the change in the cost of bank financing for firms with different degrees of credit constraint, measured by the coefficient β. The next section shows the findings.

4. Results

The main hypothesis is tested in the first row, representing the coefficient β. The goal is to check whether there is a correlation between the degree of financial constraint (here, firms that pay the highest cost for working capital loans during "normal times") and the correction in lending rates during periods of high financial instability.

Table 5 shows the estimates for the three measures of financial constraint, as mentioned in the previous section, where "normal times" corresponds to the period between January 2006 and May 2008.

Table 5

Dependent Variable:	Δ% Average Interest Rate		
	jan 2006 - may 2008		
Measures of Constraint	Minimum	Average	Volume
Independent Variables:			
Constraint	0.0111276***	0.0076004***	-0.0524403***
	[0.0034363]	[0.0031512]	[0.00979]
Firm Size	0.1880961***	0.173665***	
	[0.0209987]	[0.0200392]	
Δ Firm Credit Risk	1.163488***	1.165838***	1.223015***
	[0.1727278]	[0.1723946]	[0.1689614]
Firm Credit Risk	-0.1277867	-0.1301026	-0.2364164
	[0.1484494]	[0.1482036]	[0.1449625]
Δ Maturity	-0.0081468***	-0.0082075***	-0.0086079***
	[0.000936]	[0.0009363]	[0.0009483]
Relationship	0.201287***	0.1923064***	0.2178974***
	[0.013371]	[0.0121707]	[0.0128169]
# of banks Pre-Crisis	-0.9967536***	-0.9974929***	-0.8487827***
	[0.0437573]	[0.0453305]	[0.0372378]
Δ Proportion of public-owned lender	-3.595066***	-3.590772***	-3.566637***
	[0.1004437]	[0.100505]	[0.1006217]
R^2	0.3385	0.3376	0.3351
# of obs	45,332	45,332	45,332

*,** and *** indicate significant coefficients at 10, 5 and 1 percent, respectively.

Robust standard erros in brackets. Firm economic sector and bank dummies included.

The first column uses the minimum lending rate paid by each firm between January 2006 and May 2008 as a measure of firm financial constraint. The coefficient associated with the credit constraint, β, is 0.011276, which is significant at 1%. This means that for a 1% increase in the minimum interest rate paid in "normal times", the cost of bank financing was around 1.12% higher. This result points to the fact that more constrained firms were the most affected during the global financial crisis of 2008 in terms of cost of bank financing. The second column brings the average lending rate paid by each firm between January 2006 and May 2008 as a measure of firm financial constraint. The β coefficient is 0.0076 and significant at 1%. So, for a 1% increase in the average interest rate paid in during "normal times", the cost of bank financing was around 0.76% higher.

The third measure of constraint, the total volume of loans obtained by each firm during "normal times", presented in the third column, assumes that the total volume of loans reflects how frequent each firm accesses the banking credit market and so should have a negative correlation with the degree of firms' financial constraint. The β coefficient is -0.05244 and significant at 1%. Thus, for a 1% increase in the total

volume of loans obtained during “normal times”, the cost of bank financing was around 5.244% lower.

Hence, the findings indicate that the observed rise in the cost of bank financing during the peak of the global financial crisis of 2008 was even greater for constrained firms, that is, those that already paid higher lending rates and borrowed less during “normal times”.

Furthermore, Table 5 shows a positive correlation between firm size and the percentage change in the cost of credit during the crisis. The coefficient is significant at 1% and approximately 0.18, indicating that for a 1% increase in total credit obtained between June and December 2008, the average interest rate was 18% higher. This effect indicates that, on average, large firms suffered even more credit restrictions during the global financial crisis of 2008, confirming the suspicion indicated by the statistics presented in Table 4.

As expected, Table 5 shows a positive correlation between the change in the cost of credit and the change in the firms’ credit risk, measure by the ratio of loan loss provisions to total loans. The coefficient indicates that for a 1% increase in the firms’ credit risk, the cost of bank financing was around 1.16% higher. In addition, there is no correlation between the level of credit risk and the change in the lending rate during the crisis.

As also expected, there is a negative correlation between the lending rate and the loan maturity. Quantitatively, for a 1% increase in loan maturity the lending rate was 0.81% lower.

A long relationship between borrower and lender can reduce the problems of information asymmetry, bringing benefits to borrowers. On the other side, a longer relationship increases the information advantage of the lender, enhancing its monopoly power over the borrower. In that case, it could be detrimental to the borrower. The empirical literature provides support for both predictions. Table 5 shows there is a positive correlation between the time of relationship and the change in the lending rate during the crisis, on the order of 20% higher for a 1% increase in the time of relationship, indicating that the monopoly power reaction dominates the reduction in information asymmetry.

Additionally, for each additional bank from which firms obtained loans before the crisis, the change in the cost of bank financing was approximately 100% lower,

indicating the importance for firms to have multiple lenders and then be able to choose the best financing option in times of crisis. Moreover, the lending rate was 4.6% lower for a 1% increase in the proportion of loans from government-owned banks, reflecting the government intervention during the crisis.

For robustness purposes, Table 7 in the appendix brings the same estimates using the period between January 2006 and December 2007 as "normal times". The results are basically the same.

The findings can also be explained by the correlation between the lending rate and the existence (and its expected liquidation value) of guarantees in each loan agreement. The idea is that some firms pay lower interest rates because their borrowing is intensive in collateral, reducing adverse selection and moral hazard problems. And since collateral is particularly useful during "bad times", those contracts become valuable in periods of high financial instability, raising the interest spread between non-collateralized and collateralized loans. However, some could argue that the expected liquidation value of those assets tends to worsen during "bad times", decreasing the interest spread. That is, since the cost of external financing is associated with the value of collateral, loans backed by strong collateral – hence less risky – would suffer the greatest interest rate increases in times of crisis due to the fall in the expected liquidation value of these assets.

If the loan loss provision to total loans ratio is a good proxy for credit risk, it should capture all of these collateral effects. However, some studies have shown that banks often use their loan loss provision account to meet some specific targets, such as to smooth income. In order to disentangle such effect, I introduce in the baseline model a variable to indicate how intensive in guarantees each loan agreement is. As there is no information about the value of such guarantees in the database, only the existence of in rem guarantees could be included.

Table 6 presents the estimates of the new model, where $Collateralized\ Loans_j$ indicates the proportion of in rem guarantee between June and August 2008 for firm j and $\Delta Collateralized\ Loans_j$ is the change in the proportion of in rem guarantees after the crisis.

Table 6

Dependent Variable:	Δ% Average Interest Rate	
	jan 2006 - may 2008	
Measures of Constraint	Minimum	Average
Independent Variables:		
Constraint	0.0110271***	0.007507**
	[0.0034312]	[0.0031448]
Collateralized Loans	-0.1480098***	-0.1481799***
	[0.0380664]	[0.0378867]
Δ Collateralized Loans	-0.1779712***	-0.1807755***
	[0.0364004]	[0.0364683]
Firm Size	0.1922341***	0.1777755***
	[0.021267]	[0.020256]
Δ Firm Credit Risk	1.169589***	1.172035***
	[0.1727975]	[0.1724673]
Firm Credit Risk	-0.1335476	-0.135696
	[0.1487478]	[0.1485172]
Δ Maturity	-0.0081205***	-0.0081797***
	[0.0009351]	[0.0009354]
Relationship	0.2013056***	0.192394***
	[0.0133686]	[0.0121696]
# of banks Pre-Crisis	-0.9977665***	-0.9983738***
	[0.0437388]	[0.0453127]
Δ Proportion of public-owned lender	-3.606842***	-3.602939***
	[0.1005346]	[0.1005953]
R^2	0.3388	0.3380
# of obs	45,332	45,332

*,** and *** indicate significant coefficients at 10, 5 and 1 percent, respectively.

Robust standard erros in brackets. Firm economic sector and bank dummies included.

The results show that the lending rates during the 2008 crisis were 14.8% lower for collateralized loans relative to non-collateralized ones and 18% lower for loans that became backed by collateral during the crisis.

In general, the results show a greater rise in the cost of bank credit for more constrained firms, i.e., those that paid a higher lending rate on their bank loans before the crisis. This effect is on the order of 1% (0.7%) on the percentage change in the interest rate paid during the crisis for each positive percentage point change in the minimum (average) interest rate paid in "normal times". Another important effect is that the rise in the cost of credit during the crisis was even greater for larger firms and for those with longer relationships with their lenders, and lower for firms that borrowed

from several lenders before the crisis. Additionally, the change in the lending rates was even greater for non-collateralized loans, indicating that in rem guarantees are more valuable during periods of high financial instability.

Thus, the results presented in this article draw attention to the asymmetric effects on the cost of bank financing in times of crisis between firms with different access to bank lending.

5. Conclusions

Using micro data on bank lending, this article analyzed the impact of the 2008 global financial crisis on the cost of bank financing for firms classified as financially constrained versus those not constrained. The article presented a single measure of financial constraint: the effective cost of bank financing (the minimum and the average interest rate paid on each loan).

In line with previous research, the results indicate that the financial crisis of 2008 was more detrimental in terms of cost of credit to more financially restricted firms. In addition, some factors contribute to mitigate such supply contraction, such as the existence of in rem guarantees and a large number of lenders in the firm portfolio of financing partners.

To test the impact of the value of collateral on the cost of bank loans, some data on firms' balance sheets and loan contract features, such as the value and the type of guarantee used, would be necessary. Another important explanation for the findings is that part of the rise in the cost of credit in fact represented the increase in the cost of bank funding, which of course disproportionately affects loans with lower interest rates. I am currently gathering this information to add to the next version of this paper.

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Appendix

Table 7

Dependent Variable:	?% Average Interest Rate		
	Jan 2006 - Ded 2007		
Measures of Constraint	Minimum	Average	Volume
Independent Variables:			
Constraint	0.0106355***	0.0073146**	-0.0540712***
	[0.0033668]	[0.0032097]	[0.0107433]
Firm Size	0.1982917***	0.1838933***	
	[0.0217246]	[0.0208813]	
? Firm Credit Risk	1.149817***	1.150821***	1.2285***
	[0.1797645]	[0.1795158]	[0.1756619]
Firm Credit Risk	-0.1354628	-0.1397509	-0.2717648*
	[0.1543862]	[0.1541645]	[0.1506883]
? Maturity	-0.0088991***	-0.0089508***	-0.0092852***
	[0.0008312]	[0.0008317]	[0.0008445]
Relationship	0.2150101***	0.2073546***	0.232783***
	[0.0145615]	[0.0135269]	[0.0143359]
# of banks Pre-Crisis	-1.006413***	-1.0065***	-0.8513174***
	[0.04681]	[0.0484166]	[0.0393383]
? Proportion of public-owned lender	-3.541637***	-3.538295***	-3.516275***
	[0.1058]	[0.1059073]	[0.1058856]
R^2	0.3237	0.3228	0.3200
# of obs	40,656	40,656	40,656

*,** and *** indicate significant coefficients at 10, 5 and 1 percent, respectively.

Robust standard errors in brackets. Firm economic sector and bank dummies included.

Table 8 (Note: Standard errors in parentheses.)

Economic Sector	# of firms	Average Interest Rate Pre-crisis	Average Interest Rate Post-crisis	Var. % Interest Rate
1 - Public Administration and ONGs	219	48.36 (19.10)	55.92 (18.20)	15.63%
2 - Agriculture	777	47.07 (22.28)	54.27 (20.44)	15.29%
3 - Foods	1,804	45.39 (20.41)	52.39 (19.42)	15.42%
4 - Financial Services	361	48.37 (18.64)	56 (18.18)	15.77%
5 - Automotive	4,5223	45.93 (20.87)	53.23 (18.64)	15.89%
6 - Beverages and Tobacco	528	48.93 (22.40)	54.41 (18.86)	11.19%
7 - Construction, Wood and Furniture	9,910	47.44 (21.82)	53.42 (19.38)	12.60%
8 - Farming	1,196	46.7 (21.52)	53.69 (19.69)	14.96%
9 - Electronics	2,499	47.04 (20.97)	52.82 (17.94)	12.28%
10 - Energy	106	36.2 (17.33)	41.42 (14.15)	14.41%
11 - Machinery and Equipment	1,408	45.28 (21.17)	51.02 (19.12)	12.67%
12 - Media and Entertainment	4,786	47.92 (19.84)	54.52 (18.70)	13.77%
13 – Pulp and Paper	271	44.01 (21.62)	47.37 (16.41)	7.63%
14 – Petrochemicals	2,284	42.82 (23.26)	49.07 (20.71)	14.59%
15 - Chemicals, Pharmaceuticals and Hygiene	2,194	44.3 (19.58)	51.52 (18.74)	16.29%
16 - Health, Sanitation and Education	2,869	47.28 (21.87)	52.18 (18.51)	10.36%
17 - Services	5,535	49.18 (19.81)	55.68 (18.53)	13.21%
18 - Iron and Steel	1,110	43.77 (21.40)	48.65 (18.26)	11.14%
19 - Sugarcane	65	34.66 (22.90)	40.7 (19.82)	17.42%
20 - Telecomunication	69	48.17 (24.59)	51.24 (19.07)	6.37%
21 - Textile and Leather	6,960	46.07 (21.12)	52.21 (18.49)	13.32%
22 - Transportation	2,593	48.66 (21.46)	54.98 (20.23)	12.98%
23 - Retail	6,094	48.24 (21.38)	55.21 (19.04)	14.44%
24 - Other	965	45.06 (21.21)	51.14 (19.51)	13.49%

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